

Critical Decision 3b
Approve Start of Full Construction
of the
Dark Energy Camera Project
(for the Dark Energy Survey experiment)
at the
Fermi National Accelerator Laboratory

Office of High Energy Physics
Office of Science

Purpose

The purpose of this paper is to document the review by the Office of Science Energy Systems Acquisition Advisory Board-equivalent for Critical Decision 3b (CD-3b) “Approve Start of Full Construction” for the Dark Energy Camera (DECam) Project at the Fermi National Accelerator Laboratory (Fermilab).

The Acquisition Executive (AE), upon signature of this document, will grant approval of CD-3b. A description of the project and status of the prerequisites necessary for the critical decision approval are detailed in this document

Project Description

The goal of the DES experiment is to take the next step in understanding the nature of dark energy. There are three projects required for the DES experiment: the Cerro Tololo Inter-American Observatory (CTIO) Facilities Improvement Project (CFIP), the Dark Energy Camera (DECam), and the DES Data Management system (DES-DM). Each of these is treated as a separate project, and each project is carried out under the oversight and direction of one of the principal institutions in accordance with their project management practices. DECam is the major project and is the one to be funded by the Department of Energy (DOE), along with in-kind contributions. The other two are being funded by the National Science Foundation (NSF) and in-kind contributions.

The purpose of the DECam Project is to construct a large-scale digital camera for the study of the nature of dark energy. The camera is to be installed on the Blanco 4 meter Telescope in Chile, which is operated by the CTIO for the NSF.

The Project includes the design and fabrication of five lenses ranging from 0.5 to 1 meter in diameter, a multi-band filter system and a shutter that will provide a 2.2 degree field of view for the camera focal plane, which will be instrumented with charge-coupled devices (CCDs) containing a total of a half-billion pixels. The DECam Project includes the associated electronics, cooling, alignment and controls systems to operate the camera. The DECam Project will also produce an appropriate set of specialized spare parts and complete documentation for operation of all equipment.

The DOE deliverables are presented in the table below. A similar table for the in-kind deliverables is included in the DECam Project Execution Plan.

WBS	<u>DOE Project Completion Deliverables for CD-4</u>
1.1	Documentation sufficient to allow operation and maintenance of DECcam by CTIO staff
1.2	A completed focal plane containing 62 science CCDs and 12 guide/focus CCDs
1.3	Design and schematics for production of the 12-Channel Acquisition and transition boards (delivered to Spain DES consortium for fabrication) to read out the CCDs in the focal plane
1.3	Crates and power supplies for the front end electronics
1.4	Four DECcam filters
1.5	Imager: the vessel which houses the CCD focal plane and is equipped with the cooling and vacuum systems
1.5	Barrel: the support structure for the lenses (delivered to University College London for installation of the lenses)
1.5	Prime focus cage (which is the mechanical interface to the telescope) and barrel alignment system (hexapod)
1.6	Computer hardware to run the Survey Image System Process Integration (SISPI) applications
1.6	SISPI applications and infrastructure code

Approval Prerequisites

Design Sufficiently Mature to Start Procurement

The DECcam Project has completed the design of all the major systems and, where appropriate, is testing versions of the components that could be the final versions. For the elements that are not finalized, the project showed that there are no major issues that need to be addressed. The table below presents the design status broken out by subsystem.

Work Breakdown Structure	<u>Design Status</u>
1.2 Focal Plane Detectors	Final Design is complete for science CCDs (2k x 4k). Packages for the focus/alignment CCDs (2k x 2k) are small modifications on the 2k x 4k chip packages (same foot, connector, and interface to the focal plane).
1.3 Front End Electronics	Pre-production versions of each item exist and are being tested. If they perform properly, the designs will be final.
1.4 Optics	Final design is complete. Fabrication of the lenses is in

	progress (in-kind contribution). Final filter design is complete and being incorporated in a new request for proposal.
1.5 Opto-Mechanics	Design has been completed, including engineering analysis, finite element analysis (if required), and in some cases prototype testing. The final designs are expected to be the same or very similar to the current designs.
1.6 SISPI (mainly software)	Prototypes of all major systems exist and will be tested this fall in the integration tests.

Project Documentation

Required documentation, including the Project Execution Plan, approved on April 29, 2008, and the Acquisition Strategy, approved on October 4, 2007, were approved at or prior to the time of CD-2/3a approval. No significant changes have been required to the documentation.

Earned Value Management System (EVMS)

Consistent with DOE O 413.3A requirements for projects with a TPC > \$20M (and < \$50M), the Project has implemented an earned value management system, which was “self certified” via an earned value management review of the DECam Project conducted on December 18 and 19, 2007. This review was co-chaired by DOE-CH and Fermilab. The Project reports EVMS results each month and uses EVMS as a management tool.

Quality Assurance (QA) Program

Project work at Fermilab is covered by the laboratory QA plan. The subject is addressed in the Project’s Quality Management Plan.

Preliminary Safety Assessment Document

The Preliminary Safety Assessment Document for the Project was approved on February 20, 2008.

Environmental Strategy

The Categorical Exclusion (10CFR1021, Subpart B, Appendix B3.6) for the Dark Energy Survey was approved on July 11, 2006.

Independent Project Review

An Independent Project Review was performed by the Office of Project Assessment at the request of the Office of High Energy Physics and the National Science Foundation’s Division of Astronomical Sciences on September 9 and 10, 2008 at Fermilab. The Committee found that the DECam Project’s technical design, costs, schedule, documentation and management systems are ready for CD-3b approval. The Committee recommended that DOE approve CD-3b for the DECam Project.

Project Baseline

Cost

The DOE Total Estimated Cost (TEC) for the DECam Project is \$23.45 million, consisting of \$22.84 million in Fermilab Major Item of Equipment (MIE) funds and \$0.61 million in University of Illinois at Urbana-Champaign (UIUC) base grant funds. The Other Project Cost is \$11.7 million, consisting of \$11.25 million in Fermilab R&D funds and \$0.45 million in UIUC base grant funds. The DOE Total Project Cost (TPC) is \$35.15 million. As of the August 31, 2008, the contingency was \$7.05 million or 41 percent of the costs to complete. In addition, the Project will receive approximately \$6.5 million of in-kind contributions from universities and foreign institutions.

Following CD-2, the CD-3a approval enabled the Project to obligate approximately \$3.46M in MIE prior to the forecast date of CD-3b approval of January 2009. This includes \$2.12 million in M&S long-lead procurement for CCD processing and packaging and the hexapod procurement, and \$1.34 million in labor for final engineering and design activities.

After CD-3b approval, total scheduled obligations are: \$6.1 million in MIE procurements, \$7.1 million in labor, and \$6.8 million in contingency.

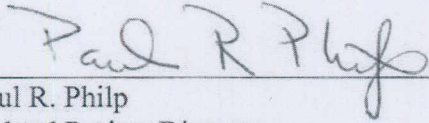
Schedule

The level 0 milestones are presented in the table below. The CD-0, CD-1, CD-2, and CD-3a milestone dates are actual dates, while the other dates are the baseline dates. CD-3 has been split into two milestones: CD-3a for construction start of long-lead items and CD-3b for construction start for the full project. The CD-4 milestone for approval of project completion is September 2012 and has approximately 15 months of schedule contingency.

Critical Decision Milestones		
Milestone	Description	Baseline Date
0.0	CD-0: Approve Mission Need (Ground-Based Dark Energy Experiment)	November 22, 2005 (a)
0.1	CD-1: Approve Alternative Selection and Cost Range	October 10, 2007 (a)
0.2	CD-2: Approve Performance Baseline	April 29, 2008 (a)
0.3a	CD-3a: Approve Limited Construction	May 20, 2008 (a)
0.3	CD-3b: Approve Start of Full Construction	January 2009 (f)
0.4	CD-4: Approve Project Completion	September 2012 (f)

**Critical Decision 3b, Approve Start of Full Construction
of the DECam Project**

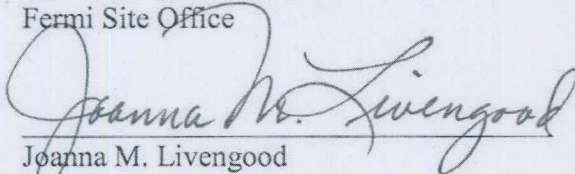
Submitted by:



Paul R. Philp
Federal Project Director
Fermi Site Office

10-20-08

Date



Joanna M. Livengood
Manager
Fermi Site Office

10/20/08

Date



Kathleen R. Turner
Program Manager
Office of High Energy Physics


10/24/08

Date


**Critical Decision 3b, Approve Start of Full Construction
of the DECam Project**

Recommendations:

The undersigned "Do Recommend" (Yes) or "Do Not Recommend" (No) approval of CD-3b, Approve Start of Full Construction, for the DECam Project at Fermilab as noted below.



ESAAB Secretariat, Office of Project Assessment 10/24/08 Yes ☒ No _____
Date

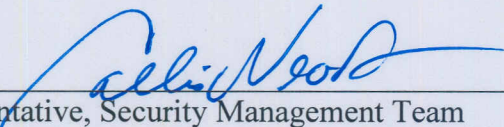


Representative, Non-Proponent SC Program Office 10/24/08 Yes ☒ No _____
Date



Representative, Office of Budget 10/24/08 Yes ☒ No _____
Date

Representative, Environmental, Safety and Health Division Yes _____ No _____
Date



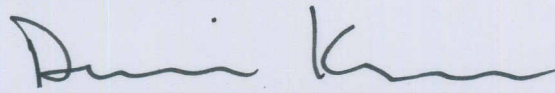
Representative, Security Management Team 10/24/08 Yes ☒ No _____
Date



Representative, Laboratory Infrastructure Division 10/24/08 Yes ☒ No _____
Date

Representative, Grants and Contracts Division Yes _____ No _____
Date

Approval of CD-3b



Dennis Kovar, Acquisition Executive
Associate Director for High Energy Physics
Office of Science 10/24/08
Date